Comparing magnitudes of tephra-mantled slope failures triggered by the 2016 Kumamoto earthquake and those triggered by rainfalls before and after the earthquake in the post-caldera central cones of Aso volcano, southwestern Japan

*Takashi Kimura[1], Naoki Sakai[1]

1. National Research Institute for Earth Science and Disaster Resilience

The M_W7.0 Kumamoto earthquake on 16 April 2016 triggered numerous landslides on hillslopes in the post-caldera central cones and the caldera walls of the Aso volcano, southwestern Japan. In this region, heavy rainfalls caused serious landslide disasters during the last decades. The heavy rainfall event in early July 2012 triggered large number of landslides, which were mainly distributed in northeastern part of the Aso volcano. The another rainfall event in late June 2016, about 2 months later of the Kumamoto earthquake, caused secondary slope failures in and around the earthquake-triggered landsliding slopes. Most of the landslides in the post-caldera central cones were considered as soil slips on tephra-mantled slopes. However, the previous reports showed that most of the landslides were shallow slope failures of 1-2 m depth at the July 2012 and other rainfall events, meanwhile many landslides with over 5 m depth were observed at the 2016 Kumamoto earthquake. These facts indicated that magnitudes of landslides were quite different from each other, depending on the property of triggering events. Quantifications of landslide magnitudes and characterizations of differences related to triggering factors and their temporal changes are thus important for hazard assessment as well as understanding sediment yield and landscape evolution in volcanic regions.

The Airborne LiDAR (Light Detection and Ranging) measurement has been conducted four times around the Aso volcano as follows: before and after the rainfall event in July 2012 (April 2010 and January 2013), just after the 2016 Kumamoto earthquake (late April 2016), after the rainfall event in late June 2016 (August 2016). We developed multi-temporal Digital Elevation Models (DEMs) with high-resolution (0.5-1 m grid) based on these LiDAR data, and measured the depth and volume of individual slope failures by computing elevation changes between each pair of DEMs for the above three events. In this report, we examine 1) how the difference of triggering factors (earthquake vs. rainfall) among the three events effects on the depth and volumetric characteristics of tephra-mantled slope failures, and 2) whether the characteristics vary considerably between the two rainfall events (before vs. after the earthquake).

Keywords: Aso volcano, Post-caldera central cones, tephra-mantled slope, landslide depth, area-volume relationship, 2016 Kumamoto earthquake